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Preparation and characterization of well-defined lignin and hemicellulose samples for the manufacture of biocomposites

Lignin, a network polymer present in the cell wall of wood, constitutes the glue of this natural composite. In wood, cellulose fibres are embedded in a matrix of lignin and hemicelluloses, making it an exceptionally strong material which resists compression. The attempts to imitate this perfect natural composite by technical processes have resulted in rather poor mechanical properties of the respective composite materials. The existing commercial products, lignin based compounds reinforced with natural fibres, suffer from low impact strength and brittleness. The low purity and reactivity of commercial lignin products is one of the reasons for the insufficient mechanical properties of these man-made composites.

The main objective of this work is to isolate defined lignin and hemicellulose samples from various biomass sources implementing different fractionation schemes to enable reliable application tests, subsequently. The samples will differ in their molecular weight, molecular weight distribution, as well as in certain functionalities relevant to the requested applications. With this approach it should be possible to establish reliable structure-property relationships.

The scope of the work includes isolation, purification and analytical characterization of lignin from a commercial kraft pulp mill as well as from laboratory sulphur-free cooks, including soda, soda-AQ, organosolv and hydrothermolysis processes. Additionally, lignin samples from other commercial and non-commercial sources, such as LignoBoost, Alcell, and oxygen pulping lignins, will be evaluated.